APPLICATION FOR UNITED STATES LETTERS PATENT

TITLE: **ROBOT CLEANER HAVING AIR CLEANING FUNCTION AND SYSTEM THEREOF**

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REFERENCE TO RELATED APPLICATIONS

This application claims priority to Korean Application No. 2003-51139, filed July 24, 2003, in the Korean Intellectual Property Office, the disclosure of which is entirely incorporated herein by reference.

CROSS-REFERENCE TO RELATED APPLICATION

This application is related to copending Korean Patent Application Nos. 10-2003-0013961, filed March 6, 2003; 10-2003-0029242, filed May 9, 2003; and 10-2003-0043244, filed June 30, 2003, whose disclosures are entirely incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to a robot cleaner with an air cleaning function and a system thereof, and more particularly, to a robot cleaner capable of cleaning ambient air in a predetermined cleaning area while performing a cleaning with respect to a floor, and a system thereof.

BACKGROUND OF THE INVENTION

Despite the convenience provided by the invention of a vacuum cleaner, cleaning is still an exhausting house chore because a user has to run the vacuum cleaner to different places of the house by himself/herself. In order to solve this problem, research has been conducted for a robot cleaner which is capable of running and cleaning automatically. Such a convention robot cleaner runs around automatically on a predetermined area and draws-in dust and dirt from a surface without requiring a user's intervention. However, the conventional robot cleaner has no air cleaning function and simply functions to clean the area surface by drawing-in dust and dirt. Recently, concern regarding the Asian Dust and Severe Acute Respiratory Syndrome (SARS), many customers are deeply interested in health and clean and fresh air. It is time that the robot cleaner includes an air cleaning function.

FIG. 1 is a view showing a conventional robot cleaner. Referring to FIG. 1, the conventional robot cleaner, i.e., having neither an air cleaning function nor an air filtering function, includes a cleaner body 7, and driving wheels 1 and driven wheels 2 disposed at a lower portion of the cleaner body 7. An upper portion of the cleaner body 7 is provided with an antenna 3 for signal transmission and reception with a remote controller, and a distance sensor 4 disposed respectively on predetermined positions.

Also, inside the cleaner body 7 are provided a driving motor (not shown) for generating a suction force and a dirt collecting receptacle (not shown). The suction force generated by the driving motor is transmitted to a suction port 5 disposed in the lower portion of the cleaner body 7 so that dust and dirt are drawn-in to the suction port 5 from a cleaning surface by the suction force.

However, the robot cleaner with the above construction, which cleans dust and dirt from the cleaning surface while running around the cleaning area according to a predetermined running pattern, has problems. First, since the robot cleaner has only a cleaning function of drawing-in dirt and dust from a cleaning surface, a user has to purchase a separate air cleaning device in order to add an air cleaning function to the robot cleaner. Second, in a case where dust is not completely drawn-in to the suction port 5 from the surface to the robot cleaner which has no air cleaning function, air in the cleaning area increases in impurity, and as a result, the user is exposed to potential harm by the unclean air.

Thus, a heretofore unaddressed need exists in the industry to address the aforementioned deficiencies and inadequacies.

SUMMARY OF THE INVENTION

The present invention has been developed in order to solve the above problems in the related art. Accordingly, an aspect of the present invention provides a robot cleaner and a system thereof which cleans ambient air in a cleaning area while cleaning a cleaning surface.

The above aspect is achieved by providing a robot cleaner with a body, a driving part driving a plurality of wheels disposed at a lower portion of the body, a dust suction part formed in the body to draw-in dust from a cleaning surface, and an air cleaning part formed in the body to draw-in dust-ladened air from a cleaning area. The robot cleaner cleans air and discharges the cleaned air. A controller is disposed in the body to control the driving part and the air cleaning part. Also, the body is connected to a body cover and forms an exterior of the robot cleaner. The air cleaning part includes a suction driving source to draw-in the dust-ladened air from the cleaning area, a suction port connected to another side of the body cover, a discharge port connected to the other side of the body cover, an air cleaning duct in fluid communication with the suction port and the discharge port, and a plurality of filters disposed in the air cleaning duct to clean the drawn-in air. The suction port may be formed in one side of a front portion of the body cover or in one side of an upper portion of the body cover. The discharge port may be formed in another side of the front portion of the body cover or in another side of an upper portion of the body cover.

In one embodiment, the suction driving source is disposed in the air cleaning duct to draw-in air.

In another embodiment, the plurality of filters include a first filter filtering relatively larger dust particles from the drawn-in air, and a second filter filtering out minute dust particles and indifferent odors from air.

The above aspect is also achieved by providing a robot cleaning system including a driving part for driving a plurality of wheels, a dust suction part for drawing-in dust from a cleaning surface, and a controller for controlling the driving part and the dust suction part. The robot cleaning system further comprises an air cleaning part controlled by the controller, wherein the robot cleaning system performs a cleaning task through the dust suction part and air cleaning work through the air cleaning part, simultaneously or selectively. The air cleaning part comprises a suction driving source for drawing-in dust-ladened air from a predetermined cleaning area, a suction port through which air is drawn-in, a discharge port through which cleaned air is discharged, and at least one filter for cleaning the drawn-in air. When the suction driving source is driven by the controller, air is drawn-in through the suction port, cleaned though the

filter, and discharged through the discharge port.

Many aspects of the invention can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present invention. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

Other systems, methods, features and advantages of the present invention will be or become apparent to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such additional systems, methods, features, and advantages be included within this description, be within the scope of the present invention and be protected by the accompanying claims.

FIG. 1 is a drawing showing a conventional robot cleaner;

FIG. 2 is a perspective drawing showing a robot cleaner system with an air cleaning part according to an embodiment of the present invention;

FIG. 3 is a perspective drawing showing the robot cleaner of FIG. 2 in which the upper cover is removed;

FIG. 4 is a drawing of a perspective bottom view showing the air cleaning part of the robot cleaner of FIG. 2;

FIG. 5 is a block diagram showing a central control device of a robot cleaner system according to the present invention; and

FIG. 6 is a drawing of a perspective view showing a robot cleaner system with an air cleaning part according to an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, a robot cleaner and a system thereof according to embodiments of the present invention will be described in greater detail with reference to the accompanying drawings.

Referring to Figs. 2-5, robot cleaner 10 includes a body 12, a body cover 11 connected to the body 12 to form an exterior of the robot cleaner 10, a dust suction part 16, and a driving part 20. The robot cleaner also includes an upper camera 30, a front camera 32, an obstacle sensor 34, an air cleaning part 60, a controller 40, a memory device 41, and a transmitting/receiving part 43. Reference sign 'I' indicates a forwarding direction of the robot cleaner 10. The dust suction part 16 is formed on the body 12 to draw-in dust-ladened air therethrough and thus collect dust from a cleaning surface. The dust suction part 16 may take many forms well-known in the art. For example, the dust suction part 16 may include a suction motor (not shown) and a dust-collecting chamber for collecting dust drawn through a suction port, or a suction pipe which is formed oppositely to the cleaning surface and operate, by the operation of the suction motor.

The driving part 20 includes two driven wheels 21 disposed at both front sides of the body 12, two driving wheels 22 disposed at both rear sides of the body 12, a pair of motors 24 for rotationally driving the two rear wheels 22, respectively, and a timing belt 25 for transmitting a driving force from the rear wheels 22 to the front wheels 21. Also, the driving part 20 rotationally drives the motors 24 independently in a clockwise direction or a counterclockwise direction in accordance with a control signal from the controller 40. The operating direction of the robot cleaner 10 can be changed by rotating the motors 24 at different RPMs. The front camera 32 is disposed on the body 12 to photograph front images and output the photographed images to the controller 40. The upper camera 30 is disposed on the body 12 to photograph upward images and output the photographed images to the controller 40. In another embodiment, the upper camera 30 employs a fish eye lens (not shown). The fish eye lens is disclosed in Korean Patent Publication Nos. 1996-7005245 and 1994-22112 and is marketed by various lens manufactures, therefore a detailed description thereof is omitted.

The obstacle sensors 34 are arranged along a circumference of the body 12 at a predetermined interval, for transmitting signals to the outside and receiving reflected signals. The obstacle sensors 34 may use an ultrasonic sensor for emitting an ultrasonic wave and receiving a reflected ultrasonic wave. The obstacle sensors 34 are also used to measure a distance to an obstacle or a wall.

Referring to FIG. 4, the air cleaning part 60 is disposed in one side of the body

12 to draw-in air from a cleaning area, and, cleaning air. The air cleaning part 60 includes a suction driving source 61, a suction port 63 connected to one side of the body cover 11, a discharge port 65 connected to another side of the body cover 11, an air cleaning duct 67, and a plurality of filters 69. The suction driving source 61 generates a suction force to draw-in dust-ladened air from the cleaning area. The suction driving source 61 may be disposed in the air cleaning duct 67 and provides a suction force in association with a suction motor (not shown) which provides a suction force to a bottom of the dust suction part of the body 12.

Accordingly, the suction driving source 61 can be embodied either in association with the driving motor (not shown) or separately from the driving motor to provide the suction force to the air cleaning part 60. The suction driving source 61 may consist of a motor and a fan system.

The suction port 63 is formed in one side of a front portion of the body cover 11 or one side of an upper portion of the body cover 11. The discharge port 65 is formed in another side of the front portion of the body cover 11, or in another side of the upper portion of the body cover 11. As shown in FIG. 2, the suction port 63 is formed in one side of the front portion of the body cover 11, while the discharge port 65 is formed in one side of a rear portion of the body cover 11. The positions where the suction port 63 and the discharge port 65 are disposed may vary. For example, the suction port 63 may be formed in one side of the front portion of the body cover 11, while the discharge port 65 may be formed in one side of the upper portion of the body cover 11 as shown in FIG. 6. Also, there may be provided at least two suction ports 63 and at least two discharge ports 65. In that embodiment, each suction port 63 and discharge port 65 may be disposed independently from the air cleaning duct 67 or may be connected to the air cleaning duct 67.

The air cleaning duct 67 is in fluid communication with the suction port 63 and the discharge port 65 so that air drawn-in through the suction port 63 by the suction driving source 61 is discharged through the discharge port 65 via the air cleaning duct 67.

As long as the fluid communication with the suction port 63 to the discharge port 65 is ensured, the fluid communication line may take various forms such as a straight line or a curved line.

The plurality of filters 69 function to clean air which is drawn-in through the suction port 63. The filters 69 include a first filter 71 and a second filter 73. The first filter 71 filters out relatively larger dust particles from air while the second filter 73 filters out relatively minute dust particles and undesirable odors from the large dust-

removed air. In another embodiment, the second filter 73 may use a general HEPA filter to filter minute bacteria and viruses, molds, house and animal dust which may cause human respiratory system disorders and allergies. The second filter 73 may use a general deodorizing filter for removing various scents.

The controller 40 processes signals received through the receiving/transmitting part 43 and controls the respective components accordingly. The robot cleaner 10 may further include a key input apparatus (not shown). In that embodiment, the key input apparatus (not shown) is formed in the body 12 and includes a plurality of keys for function setting of the robot cleaner, and the controller 40 processes a key signal inputted through the key input apparatus (not shown).

The controller 40 operates the dust suction part 16 or the driving part 20 and instructs the robot cleaner 10 to perform a cleaning task around a cleaning area. The controller 40 also operates the air cleaning part 60 at the same time. By operating the driving part 20 and the air cleaning part 60 together, but not operating the dust suction part 16, the robot cleaner 10 can perform an air cleaning function only while traversing around the cleaning area.

The memory device 41 stores the photographed upward images captured by the upper camera 30 in order for the controller 40 to calculate location information and traveling information. The receiving and transmitting part 43 transmits data to an external device 80 via a transceiver (not shown) mounted in the controller 40 (not shown) and also transmits signals received from the external device 80 via the transceiver to the controller 40. The external device 80 is a wireless relay apparatus (not shown), or a remote controller (not shown) through which data is inputted/outputted. In that embodiment, the external device 80 is a remote controller.

The following is a detailed description of the operations of the robot cleaner system having the air cleaning function with the above construction. When a work command is received from the external device 80, the robot cleaner 10 perceives the work command through the transmitting/receiving part 43. Depending upon whether the work command is for a cleaning work or an air cleaning work, the controller 40 initiates operation of the driving part 20, the dust suction part 16, or the air cleaning part 60. Accordingly, traversing a predetermined area automatically, the robot cleaner 10 performs the cleaning work through the suction part 16 and the air cleaning work through the air cleaning part 60, or selectively performs the cleaning work and the air cleaning work.

When the suction driving source 61 is driven by the controller 40, air is drawn-in through the suction port 63, cleaned by the filters 69 of the air cleaning part 60, and

then discharged through the discharge port 65. When a signal to stop the operation of the driving part 20 is inputted through the external device 80, the robot cleaner 10 stops at a predetermined position, but keeps performing the air cleaning work. As described above, the robot cleaner 10 performs the cleaning work and the air cleaning work simultaneously or selectively. Since the above described robot cleaner and a system thereof for cleaning a surface has the air cleaning function, a user is not required to purchase an extra air cleaner, hence, an advantage to the user. Also, since the robot cleaner provides cleaned and fresh air for a predetermined cleaning area, it contributes to a fresher residential environment.

The foregoing embodiments and advantages are merely exemplary and are not to be construed as limiting the present invention. The description of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures.